The Relationship Between Neuropsychological Performance, Cognitive Confidence, and Obsessive-Compulsive Phenomena: A Pilot Study

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Drawing on neuropsychological and cognitive-behavioral approaches to Obsessive-Compulsive Disorder (OCD), the present study examined the association between memory performance, cognitive confidence, and OCD phenomena. Forty-six analogue participants completed a series of self-report questionnaires and neuropsychological tasks before and after a manipulation of confidence in memory. It was found that cognitive confidence predicts OCD symptoms over and above the influence of depressive symptoms and other OCD-related beliefs. Participants reported higher levels of cognitive confidence following positive feedback on the manipulation task. However, changes in cognitive confidence following the manipulation task were not reflected in neuropsychological performance. Implications for theory and treatment are discussed.

Obsessive-compulsive disorder (OCD) is a severe and debilitating anxiety disorder characterized by obsessions and compulsions. It is a major cause of both social and vocational disability. Despite some variation in epidemiological studies the lifetime prevalence of OCD is believed to be between 1-2% of the general population (Clark, 2004; Fontelle, Mendlowicz, & Versiani, 2006). OCD is known to commonly be comorbid with a number of neuropsychiatric disorders and “OC spectrum” disorders, especially Gilles de la Tourette’s Syndrome and Body Dysmorphic Disorder, which may indicate a possible common underlying neurological basis (Bienvenu et al., 2000; Ivarsson, Melin, & Wallin, 2008).

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The two empirically supported treatments for OCD are psychopharmacological treatments, and cognitive-behavioral therapy (NIHCE, 2005), which are derived from biological research (e.g., neurological and neuropsychological models), and psychological models (e.g., cognitive and behavioral models) respectively. To date, most investigations have considered these models separately, with little investigation spanning across paradigms. However, consideration of both approaches is of some importance. As noted by Moritz et al. (2005), psychological interventions would be hampered if deficits in abstract-logical thinking and forgetfulness are apparent in the disorder. Further, if there are deficits in executive functioning, the resultant lack of mental flexibility may impact the patient's ability to transfer such skills acquired in therapy to everyday life (Moritz et al., 2005). Finally, neurocognitive impairment may lead to additional functional impairment (e.g., in work and social relations) that could exacerbate psychopathology. Thus, if there are neurocognitive deficits associated with a disorder such as OCD, or a subgroup of patients with the disorder, there may also need to be specialized treatment programs that account for such deficits.

Neuropsychological research has suggested that OCD is characterized by specific neuropsychological deficits, for instance in attention, concentration, executive function, and memory (for review see Greisberg & McKay, 2003). In particular, OCD patients have been examined for possible memory deficits, following the doubt and uncertainty associated with the disorder (for review see Muller & Roberts, 2005). However, empirical findings have been inconsistent, with studies variously showing that OCD is associated with impairments in verbal and spatial memory (e.g., Segalás et al., 2008), deficits only in spatial memory (e.g., Cha et al., 2008), or not with memory impairment at all (e.g., Jelinek, Moritz, Heeren, & Naber, 2006; Moritz, Kloss, von Eckstaedt, & Jelinek, 2009).

The inconsistent association between memory impairments and OC symptoms has led to investigations of the role of executive function in the pathogenesis of OCD, which may underlie possible memory deficits. For example, Savage et al. (2000) argued that OCD patients use less systematic organizational strategies when encoding and therefore are unable to retrieve memories as well as do control participants. Research in this area has focused on deficits in set-shifting, manipulation of spatial information, planning, and organization; but it has again produced inconsistent findings (for review see Greisberg & McKay, 2003; Kuelz, Riemann, Halsband et al., 2006). Although OCD patients often perform as well as control groups on many neuropsychological tasks, their performance is characterised by increased response times, perseveration of incorrect responses and problems using feedback constructively (Olley, Malhi, & Sechdev, 2007).

Veale, Sahakian, Owen, and Marks (1996) investigated executive functioning in OCD patients using the Tower of London (TOL) task in the Cambridge Neuropsychological Test Automated Battery (CANTAB), which is designed to assess spatial planning. They found no difference in accuracy between OCD patients and healthy controls. However, OCD performance was characterized by slower thinking latencies especially following a mistake. Veale at al. (1996) suggested that OCD patients are easily distracted, impaired in their ability to plan alternative sub-goals and that they spend more time excessively monitoring and checking responses. Using a non-computerized version of the TOL task, Bohne et al. (2005) also found that OCD performance was characterized by increased thinking latencies and longer planning time. Poor performance on the CANTAB’s spatial working memory (SWM) task has also been associated with OCD (Nedeljkovic, 2006; Nedeljkovic, Kyrios, Moulding et
al., 2009; Purcell, Maruff, Kyrios & Pantelis. 1998). OCD performance on the SWM task has been characterized by more errors and a lack of a strategic searching technique (Nedeljkovic, 2006; Nedeljkovic, Kyrios, et al., 2009; Purcell et al., 1998).

The inconsistent results in neuropsychological research have provided impetus to other theories of OCD pathogenesis, including the cognitive-behavioral approach (e.g., Rachman, 1997, 2002; Salkovskis, 1985; Wells, 1997). Although these models differ in the specific cognitions responsible for OCD development, they tend to revolve around a number of common ideas and assumptions. Cognitive-behavioral models are based on research that intrusive thoughts, images, and impulses are experienced by the majority of the population (Rachman & de Silva, 1978; cf. Julien, O’Connor, & Aardema, 2007). These thoughts escalate into obsessions as a result of faulty appraisals and maladaptive coping responses (Rachman, 1997). For example, neutralization behaviors (e.g., thought suppression, internal and external compulsions) aim to reduce this anxiety and counteract the negative effect of the intrusion, but in the long term increase the salience of intrusive thoughts (Salkovskis, 1985; Salkovskis, Thorpe, Wahl, Wroe, & Forrester, 2003). In particular, an overinflated sense of responsibility for danger, beliefs about the importance of thoughts, perfectionism, and elevated appraisals of danger have been the focus of these models (e.g., OCCWG, 2005).

Rachman (2002) developed a specific model of compulsive checking. He argued that individuals who believe they have an elevated responsibility to prevent harm repeatedly check for safety, but the probability of future harm can never be fully eliminated and checking is repeated indefinitely. The repeated checking interferes with memory, as attention is focused on potentially threatening stimuli and anxiety levels are elevated. Reduced memory of the check lowers the individual’s confidence in his or her memory, which reduces his or her certainty that harm has been avoided and encourages further checking. Empirical research has supported this notion that repeated checking decreases confidence in memory and leads to further checking (Coles, Radomsky, & Horng, 2006; van den Hout & Kindt, 2003a, 2003b; see also Wells, 1997, 2000; Wells & Matthews, 1994).

While cognitive models have received research support and are associated with effective treatments (Clark, 2004), these models have rarely been considered in relation to neuropsychological findings, and it has been argued that they do not explain the full nature of OCD. Van den Hout and Kindt (2003b) suggest that while these models explain the motivation to engage in neutralizing behavior they do not explain the preservative and repetitive nature of OC symptoms.

One of the only concepts to have infiltrated into both neuropsychological research and cognitive research is metamemory; metacognitions or self-monitoring judgments about memory and related processes (Nelson & Narens, 1990). Research investigating confidence in memory has consistently supported the association between OC symptoms and low confidence in memory (Cougle, Salkovskis, & Wahl, 2007; Moritz et al., 2007; Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, Kyrios, & Doron, 2009; Tuna, Tekcan, & Topcuoglu, 2005; see Woods, Vevea, Chamberless, & Bayen, 2002 for review). Reduced confidence in memory has also been associated with other beliefs related to OCD (e.g., inflated responsibility and perfectionistic standards; Cougle et al., 2007; Moritz et al., 2007; Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, et al., 2009). Furthermore, there has also been a significant association between reduced confidence in cognitive processes other than memory (e.g., attention and decision making) and OC symptoms (Hermans et al., 2008; Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, et al., 2009). The majority of research so far has focused on
a general state measure of confidence; however, research by Nedeljkovic and Kyrios (2007) suggests that there may be a general trait of reduced cognitive confidence that may constitute a vulnerability to OCD.

Although research has shown significant support for decreased confidence in memory in OCD, it has focused primarily on checking compulsions (e.g., Rachman, 2002). Research has illustrated a vicious cycle between repeated checking and reduced confidence in memory (Coles, Radomsky, & Horng, 2006; Rachman, 2002; van den Hout, and Kindt, 2003a, 2003b). Low confidence in memory leads to doubt about past checking and repeated checking leads to reduced confidence in memory. Given the cyclic nature of confidence in memory and OC symptoms there is debate amongst theorists about which came first. Van den Hout & Kindt (2003a, 2003b) argue that repeated checking reduces the vividness of recollections about past checking events and therefore decreases confidence in memory. However, the concept of a reduced confidence trait that constitutes a vulnerability to OCD (Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, et al., 2009) suggests that low confidence leads to repeated checking. The role of cognitive confidence in maintaining OCD has received significant support. However, the true nature of the relationship between OCD, cognitive confidence, and cognitive processes is not yet fully understood.

Drawing on neuropsychological and cognitive-behavioral approaches to OCD, the current study aims to further investigate the role of cognitive confidence in the development and maintenance of OC symptoms, using a student sample. This study aimed to investigate the relationship between OC symptoms and cognitive confidence, providing further support for the association between reduced cognitive confidence and increased OC symptoms (Nedeljkovic, & Kyrios, 2007; Nedeljkovic, Moulding, et al., 2009). The present study also aimed to examine the relationship between OCD and neuropsychological performance on spatial working memory and executive function tasks, which have been shown by previous research to be sensitive to detecting neuropsychological deficits in OCD (Nedeljkovic, Kyrios, et al. 2009; Purcell et al., 1998). Furthermore, we aimed to extend on the work of previous researchers by further examining the relationship between metamemory and neuropsychological performance by manipulating confidence in memory and investigating its effects on neuropsychological performance. Therefore, the present study aimed to examine whether patterns of impaired neuropsychological performance observed in patients with OCD might result from maladaptive cognitive appraisals and test-taking attitudes rather than structural or functional neurological deficits.

Based on previous research by Nedeljkovic and Kyrios (2007), it was predicted that high levels of OC symptoms would correlate with low confidence in memory and other related processes. It was also hypothesized that cognitive confidence would significantly predict OC symptoms over and above depression and other OCD-related beliefs. Furthermore, it was expected that confidence in memory would be the best predictor of OC symptoms especially in relation to compulsive checking. Based on previous neuropsychological research (Nedeljkovic, Kyrios et al., 2009; Purcell et al., 1998), it was hypothesized that high levels of OCD symptoms would correlate with poor performance on specific neuropsychological tasks. Consistent with suggestions in previous research (e.g., Nedeljkovic, Kyrios, et al., 2009), it was also hypothesized that low cognitive confidence would be associated with relatively poorer performance on the neuropsychological tasks. Finally, it was hypothesized that confidence in memory and neuropsychological performance would improve following increased positive feedback on a memory manipulation task.
METHOD

Participants

Forty-eight undergraduate psychology students participated in the current study in exchange for course credit. Two participants were excluded as they completed less than 60% of the questionnaires. In the final sample there were 46 respondents (31 female, 13 male, 2 not specified), with ages from 18 to 49 ($M = 23.67, SD = 7.24$). Of these, 4% were in full-time employment, 20% part-time, and 54% casually employed. Most of the sample was born in Australia (89%).

The use of nonclinical populations within research on OCD is a common practice. Such studies follow findings that nonclinical populations experience similar intrusive thoughts to clinical populations, albeit with lesser frequency and resulting distress (Rachman & de Silva, 1978). Two recent taxometric studies have directly examined this issue of whether OCD symptoms can be considered as dimensional or categorical (Haslam, Williams, Kyrios, McKay, & Taylor, 2005; Olatunji, Williams, Haslam, Abramowitz, & Tolin, 2008). They found most potential subtypes to be dimensional, with the exception of hoarding symptoms. Similarly, the belief domains measured by the OBQ were also found to be dimensional. On balance, these results are consistent with a dimensional model of beliefs and symptoms in OCD and support the appropriateness of studying OCD-related phenomena in nonclinical subjects (see also Gibbs, 1996).

Materials

The Obsessive Beliefs Questionnaire-Revised (OBQ-44; Obsessive-Compulsive Working Group [OCCWG], 2005) was used to measure beliefs that are important in the maintenance of OC symptoms. In both clinical and nonclinical populations the OBQ-44 has shown adequate psychometric properties.

The Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) was used to assess the severity and diversity of OC symptoms. The total OCI-R and each of its six subscales have shown good to excellent internal consistency, test-retest reliability, and convergent validity (Foa et al., 2002).

The Depression Anxiety Stress Scales-Short Form (DASS-21; Lovibond & Lovibond, 1995) consists of 21 self-descriptive items assessing three subscales—depression, anxiety, and stress. The good psychometric properties of the subscales have been well documented (e.g., Antony, Bieling, Cox, Enns, & Swinson, 1998).

The Memory and Cognitive Confidence Scale (MACCS; Nedeljkovic & Kyrios, 2007) was used to assess confidence in memory and other cognitive abilities. The MACCS has shown satisfactory reliability and validity (Nedeljkovic & Kyrios, 2007).

The Cambridge Neuropsychological Test Automated Battery (CANTAB; Morris, Evendon, Sahakian, & Robbins, 1987) was used to assess neuropsychological performance. The spatial working memory and stockings of Cambridge tasks were used in the current study, as they have previously been sensitive to neuropsychological deficits in OCD patients (Purcell, et al., 1998; Nedeljkovic, Kyrios, et al, 2009). The spatial working memory (SWM) task requires participants to locate a token which is hidden under one of the numerous boxes displayed on the computer screen. Participants were
told not to return to the same box twice in one trial, as the token only appears once under each box. The SWM task measures the number of times a participant returned to a box where the token had already been collected in a previous searching sequence and a strategy score which measures the participant’s ability to use a systematic searching approach. The stockings of Cambridge (SOC) task was used to assess participants’ spatial planning. This task is an adaptation of the Tower of London task (Simpson et al., 2006). Participants were instructed to arrange three colored balls in a specific pattern in the minimum number of moves possible. The SOC task measures thinking time and accuracy.

The Pattern Recognition Confidence Manipulation (PRCM) Task was used to enhance participants’ confidence in their cognitive abilities. At the beginning of the PRCM task participants were told that the task was designed to be quite difficult and the average correct response rate was 50%. Participants were also asked to rate their confidence in their ability to perform well on a memory task at the beginning and end of the task. Participants were shown 30 unique stimuli for a brief period of time and then shown a particular symbol and asked, “Was this card in the display screen?”

Participants were given a few seconds to answer and then given immediate feedback. The task was automatically adjusted throughout by altering the length of presentation of items, to ensure it was sufficiently difficult for participants to remember the patterns (performance around 40–60%). The experimental group were given increased positive feedback regardless of their actual performance and the control group were not given feedback. After the manipulation the experimental group were presented with a graph that said participants had a correct response rate greater than 90%, while the control group were given no feedback.

Procedure

Participants voluntarily gave informed consent, and completed the tasks individually. Participants completed the questionnaires (OBQ-44, OCI-R, MACCS, DASS-21) followed by the neuropsychological tasks using the CANTAB. The PRCM task was then administered to both groups. Participants randomly assigned to the experimental group (22 participants) were given increased positive feedback (over 90%) irrelevant of their performance, while the control group (24 participants) received no feedback. All participants rated their confidence on task performance using a single-item questionnaire. Participants were then asked to complete the neuropsychological tasks and the MACCS questionnaire again. At the end of the research experiment participants were fully debriefed as to the nature of the task and any deception used.

RESULTS

Data was analyzed using SPSS 16.0. Two cases were removed as these participants completed less than 60% of the questionnaires. Another two cases were found to have missing values greater than 40% on the MACCS scale after the manipulation. These cases were excluded from analyses involving the MACCS scale after the manipulation but included in all other analysis. Assumptions of heterogeneity and multicollinearity
TABLE 1. Pearson Correlations between Measures of Neuropsychological Performance, Cognitive Confidence, OC Symptoms and Beliefs (before manipulation)

<table>
<thead>
<tr>
<th></th>
<th>OBQ-44</th>
<th>MACCS</th>
<th>CIM</th>
<th>SWM BSE</th>
<th>SWM Strategy</th>
<th>SOC MITT</th>
<th>SOC MSTT</th>
<th>SOC PSMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCI-R</td>
<td>.40**</td>
<td>.59**</td>
<td>-.08</td>
<td>.01</td>
<td>-.02</td>
<td>-.03</td>
<td>.10</td>
<td>-.11</td>
</tr>
<tr>
<td>OBQ-44</td>
<td>—</td>
<td>.45**</td>
<td>-.04</td>
<td>.21</td>
<td>.31*</td>
<td>-.15</td>
<td>.13</td>
<td>.23</td>
</tr>
<tr>
<td>MACCS</td>
<td>—</td>
<td>—</td>
<td>.16</td>
<td>.20</td>
<td>-.07</td>
<td>.10</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>CIM</td>
<td>—</td>
<td>.06</td>
<td>—</td>
<td>.05</td>
<td>.20</td>
<td>.24</td>
<td>-.12</td>
<td></td>
</tr>
<tr>
<td>SWM BSE</td>
<td>—</td>
<td>—</td>
<td>.64**</td>
<td>-.26</td>
<td>-.06</td>
<td>.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SWM Strategy</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>.25</td>
<td>-.20</td>
<td></td>
<td>.13</td>
<td>.07</td>
</tr>
<tr>
<td>SOC MITT</td>
<td>—</td>
<td>—</td>
<td>.24</td>
<td>—</td>
<td>.24</td>
<td></td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>SOC MSTT</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>.02</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOC PSMM</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 46. OCI-R = OCI-R total, OBQ-44 = OBQ-44 total, MACCS = MACCS total, CIM T1= One-item confidence in memory measure on the PRCM task prior to the manipulation, SWM BSE T1 = Number of between search errors on the SWM task prior to the manipulation, SWM Strategy T1 = Strategy score on the SWM task prior to the manipulation, SOC MITT T1= Mean initial thinking time on the SOC task before the manipulation, SOC MSTT T1= Mean subsequent thinking time on the SOC task before the manipulation, SOC PSMM T1= Problems solved in the minimum number of moves on the SOC task before the manipulation. *p < .05, **p < 0.01

were met for regression analyses, while normality and homogeneity were acceptable for ANOVAs.

Initially, Pearson’s correlations were examined between measures and OCD symptoms at baseline (see Table 1). There was a strong positive correlation between the OCI-R and metacognition (r = .59), with high levels of OC symptoms being associated with low confidence in one’s cognitive abilities. There was a moderate-to-strong positive relationship between OCD-related beliefs (OBQ-44) and cognitive confidence before the manipulation (MACCS T1). State confidence in memory at baseline (CIM T1) was not significantly correlated with general OCD related beliefs or symptoms, but was correlated with trait confidence in memory. None of the neuropsychological tasks related to OCD symptoms. However, there was a significant positive correlation between strategy scores on the SWM task and OC beliefs. Therefore, high strategy scores, which indicate poor use of a systematic searching approach, were associated with high levels of OC beliefs.

Hierarchical regressions were used to examine the prediction of OCD symptoms. To control for depression and OCD beliefs, the DASS-depression was entered in Step 1, followed by the OBQ-44 in Step 2, and the MACCS T1 in Step 3 (see Table 2). The model explained 37.1% of the variance in OCD symptoms. In the final model, only cognitive confidence was a significant predictor of OCD symptoms.

To examine the relationship between cognitive confidence and OC symptoms in more detail, two further hierarchical regressions were undertaken (Table 3). The first hierarchical regression examined the ability of each of the four subscales of the MACCS to predict OC symptoms (OCI-R), over and above depression. Examination of the different subscales indicated that confidence in attention and concentration uniquely explained 18.2% of the variation in OC symptoms. Also, perfectionistic standards regarding one’s memory uniquely explained a further 8.8% of the variance in OC symptoms. Confidence in memory and confidence in decision making were not unique predictors of the variance in OC symptoms. Given the theoretical importance of confidence for checking compulsions, this analysis was rerun to predict check-
ing compulsions. Confidence in attention and concentration was the only significant predictor of checking compulsions and uniquely explained 14.4% of the variance in checking symptoms. Again, confidence in memory did not significantly predict checking compulsions.

**Pattern Recognition Confidence Manipulation**

The manipulation check found that the cognitive confidence manipulation significantly increased state confidence in memory, with a significant interaction between condition and time, $F(1,44) = 43.37$, $p < .01$, $\eta^2_p = .50$. Participants in the experimental condition showed increased confidence in memory following the manipulation task, while participants assigned to the control condition demonstrated reduced confidence in memory. Thus, the manipulation worked as expected (see Figure 1). For the MACCS, there was also a significant interaction between group and time, $F(1,42) = 7.55$, $p < .01$, $\eta^2_p = .15$, with a similar pattern of results.

Mixed model ANOVAs were used to test the effects of the confidence in memory manipulation on specific neuropsychological performance. Data was separated into high and low symptom groups using a median split based on OCI-R scores, with three cases with OCI-R scores equal to the median being excluded from the analysis. For the neuropsychological tasks, there were no significant effects of the manipulation ($p > .05$). However, this may have been due to low power, and so we also examined the overall trends of the analysis. This indicated that participants with high OCD symptoms showed greater improvement on the SWM task if they were assigned to the control condition than the experimental condition. In contrast, participants with low OCD symptoms improved at a greater rate if they were assigned to the experimental condition. On the SOC task, the overall trends illustrated that participants’ mean subsequent thinking time was more likely to decrease at a greater rate in participants assigned to the control condition than the experimental condition. A similar pattern was found for the number of problems participants solved in the minimum number of moves.

The manipulation had little effect on mean initial thinking time for participants with low levels of OC symptoms. However, participants with high levels of OC symptoms showed differences in mean initial thinking time depending on the condition they were assigned to. That is, participants in the experimental group showed decreased mean initial thinking time after the manipulation task, while participants in

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**TABLE 2. Summary of Hierarchical Regression Analysis Predicting OC Symptoms from Depression, OCD Related Beliefs, and Cognitive Confidence**

<table>
<thead>
<tr>
<th>Step</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>ΔR²</th>
<th>F-change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 (DASS-Dep)</td>
<td>.09</td>
<td>.425*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2 (OBQ-44)</td>
<td>.11</td>
<td></td>
<td></td>
<td>6.16*</td>
<td></td>
</tr>
<tr>
<td>Step 3 (MACCS T1)</td>
<td>.17</td>
<td></td>
<td>11.26**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DASS Depression 0.10 0.15 .09
OBQ-44 0.01 0.01 .16
MACCS T1 0.04 0.01 .48**

Note. N = 46. DASS Depression = Depression subscale of the DASS-21, OBQ-44 = OBQ-44 total, MACCS T1 = MACCS total before the manipulation. Coefficients at step 3. *$p < .05$, **$p < .01$
the control condition showed increased mean initial thinking time following the manipulation task (see Figure 2).

**DISCUSSION**

As expected the current study found that cognitive confidence significantly predicted variation in OC symptoms over and above other OCD related beliefs and depression. However, contrary to expectations, confidence in attention and concentration was the best predictor of OC symptoms and compulsive checking rather than confidence in memory. Furthermore, the present study found no significant relationship between neuropsychological performance and OC symptoms or cognitive confidence. An association was found between impaired spatial working memory and OCD-related beliefs. The experimental manipulation successfully influenced confidence in memory. However, this increase in cognitive confidence did not significantly affect neuropsychological performance.

The finding that low cognitive confidence was associated with high levels of OC behavior is consistent with neuropsychological and cognitive-behavioral findings of reduced confidence beliefs in individuals with high levels of OC symptoms (Cougle et al., 2007; Cougle, Salkovskis, & Thorpe, 2008; Hermans, Martens, DeCort, Pieters, & Eelen, 2003; Merckelbach & Wessel, 2000; Moritz et al., 2007; Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, et al., 2009; Tuna et al., 2005; Zermatten & Van der Linden, 2008). Unexpectedly, examination of the different aspects of cog-
nitive confidence illustrated that confidence in attention and concentration was the best predictor of OC symptoms and checking compulsions. This is consistent with a growing number of studies that have found an association between OC symptoms and reduced confidence in attention in both clinical and nonclinical populations (Hermans et al., 2003; Hermans et al., 2008; Nedeljkovic & Kyrios, 2007).

Nedeljkovic and Kyrios (2007) speculated that reduced confidence in one’s attention and concentration may lead to repeated checking as this belief breeds doubt regarding whether or not one has adequately attended to all of the different aspects of “the check.” Alternatively, intrusive thoughts and obsessions may interfere with the individual’s ability to focus or concentrate on the check. According to Wells’s metacognitive model (1997, 2000; Wells & Matthews, 1994), OCD patients focus on internal thoughts and processes rather than external events. Therefore, when carrying out neutralizing or compulsive behaviors, attentional resources are consumed by internal obsessive thoughts and fantasies concerning the negative consequences of these thoughts. Despite confirmation from sensory input that the action has been executed, OCD patients do not attend to the behavior. According to this model, the absorption of attentional resources by internal processes reduces confidence in memory, which along with beliefs concerning the importance of neutralizing behavior, increases OC symptoms (Wells, 1997, 2000; Wells & Matthews, 1994).

The hypothesis that poor neuropsychological performance would be associated with high levels of OC symptoms was not supported. This is inconsistent with previous research, such as by Purcell et al. (1998; Bohne et al., 2005; Nedeljkovic, 2006; Nedeljkovic, Kyrios, et al., 2009; Veale at al., 1996), although as noted above, there have been inconsistencies in the literature (Simpson et al., 2006). This is despite our efforts to use a small targeted range of neuropsychological tests that have shown sensitivity in OCD symptoms in the past (e.g., Bohne et al., 2005; Nedeljkovic, 2006; Nedeljkovic, Kyrios et al. 2009; Purcell et al., 1998; Veale at al., 1996). However, it is obviously of note that we tested analogue rather than clinical participants, who may not have shown large deficits.

FIGURE 1. Mean effect of the confidence manipulation on state confidence in memory, as measured by the PRCM task.
Despite these caveats, the inconsistencies seen in the current research and past studies suggest that OCD patients may not have large neurological deficits. Current research has now started to suggest that rather than impaired memory and executive functioning per se, OCD patients have reduced confidence in these processes (e.g., Cougle et al., 2008; Hermans et al., 2003; Merckelbach & Wessel, 2000; Moritz et al., 2007; Muller & Roberts, 2005; Rubenstein, Peynirdoglu, Chambers, & Pigott, 1993; Zermatten & Van der Linden, 2008). It is also possible that reduced cognitive confidence and other OCD-related beliefs interfere with neuropsychological performance. For example, the tendency for OCD patients to focus on internal processes rather than external events (Wells, 1997, 2000; Wells & Matthews, 1994) may interfere with neuropsychological performance on tasks that assess attention. Metacognitive beliefs related to the suppression and control of thought may lead individuals to constantly monitor and suppress unwanted intrusive thoughts, a process that places demands on attentional resources (Wells, 1997, 2000; Wells & Matthews, 1994). The absorption of attention may also lead to reduced working memory capacity which would interfere with one’s ability to mentally manipulate and organize spatial information.

Our findings give some support to such assertions with one of the neuropsychological measures correlating with OCD beliefs. Thus, as OCD-related beliefs increase, the use of strategic searching techniques decreased. Future research on the effects of beliefs on neuropsychological research is clearly warranted. This would be consistent with research by Kuelz et al. (2006), who demonstrated that cognitive-behavioral therapy (CBT) led to improvements on some neuropsychological tasks. Similarly, Marker, Calamari, Woodard, and Riemann (2006) found that metacognitive beliefs concerning cognitive self-consciousness predicted variation in neuropsychological performance.

The experimental manipulation of confidence in memory was successful. It was expected that an increase in cognitive confidence would reduce the need to repeatedly check answers and reduced perseveration of incorrect responses (Olley et al., 2007;
Veale et al., 1996) which would lead to an improvement on specific neuropsychological tasks. However, contrary to expectations increased cognitive confidence did not significantly improve neuropsychological performance. Given the low power of the present study the trends of the data were examined. The general trends of the data for the SWM task showed that unlike participants with high levels of OC symptoms, participants with low levels of OC symptoms were more likely to improve if they were assigned to the experimental condition. These trends suggest that high levels of OC symptoms may interfere with improvement on neuropsychological performance with repeated trials. This could be due to the impact of other beliefs (e.g., perfectionism) or the interference of symptoms.

Furthermore, on the SOC task participants with high levels of OC symptoms tended to have shorter mean initial thinking times following increased cognitive confidence and longer mean initial thinking times following the decrease in cognitive confidence. Decreased initial thinking time following increased cognitive confidence may indicate that participants were less hesitant and distracted by feelings of doubt and uncertainty. Therefore, this finding suggests that high cognitive confidence reduces uncertainty and allows participants to begin solving the task a lot faster. This improvement in neuropsychological performance may lead to positive effects on functioning in the real world. However, this finding should be interpreted with caution given the inconsistencies in the current study and in light of inconsistencies in the literature. These findings do provide a preliminary investigation of the effects of manipulating cognitive confidence on cognitive functioning.

There are a number of limitations to the present study that require consideration when interpreting the present findings and contemplating future research in this area. The main limitation of the current study was the restricted power due to a small sample size. While efforts were made to reduce the impact of reduced power, by using only selected tests which have been shown to be sensitive in previous research and thus restricting the number of comparisons, the effects were still quite small. This may have been particularly important with respect to the relationship between neuropsychological performance and OCD. Also, the use of an analogue sample may have further reduced the power due to restricted range of OCD behavior. While the range of values on OCD symptom measures showed a wide spread of values, including values within the clinical range, the majority of values were in the subclinical range. This may have again been particularly problematic in detecting neuropsychological deficits. Future research that includes clinical samples is needed to examine these relationships as well as to further confirm the role of cognitive confidence in OCD.

Nonetheless, the current findings support the notion of a general trait of reduced cognitive confidence. It is possible that a general trait of reduced cognitive confidence may constitute a vulnerability to the development of OCD as well as the maintenance of symptoms through a vicious cycle of reduced confidence and a need for certainty. The study failed to provide evidence for the role of neuropsychological deficits in OCD. Furthermore, the study suggests that reduced cognitive confidence and other OCD-related beliefs may interfere with neuropsychological performance. This may partially explain the findings of neuropsychological deficits in some OCD patients.

This study has implications for the treatment of OCD. The lack of evidence for a relationship between neuropsychological deficits and OCD symptoms indicates that specialized treatments that attempt to circumvent the effect of neuropsychological difficulties on treatment may not be necessary (cf. Moritz et al., 2005). The current findings suggest that it would be beneficial for CBT and other treatment methods to
target cognitive confidence and related processes as this could improve daily functioning. This is consistent with previous research that has demonstrated that therapies involving a metacognitive rationale in addition to exposure and response prevention experiments are more successful than traditional treatment methods (Fisher & Wells, 2008).

REFERENCES


